Check List the journal of biodiversity data

ANNOTATED LIST OF SPECIES

Check List 16 (6): 1421–1431
https://doi.org/10.15560/16.6.1421

PENSOFT

New records of lichenized fungi in Sierra Nevada de Santa Marta, Colombia

Kevin Ramírez-Roncallo, Hugo Gómez-Ramírez, María A. Negritto

Universidad del Magdalena, Grupo de Investigación en Manejo y Conservación de Fauna, Flora y Ecosistemas Estratégicos Neotropicales – MIKU, Carrera 32 # 22-08 Sector San Pedro Alejandrino, Santa Marta D.T.C.H., Magdalena, 470004, Colombia.
Corresponding author: Kevin Ramírez-Roncallo, kramirezroncallo@gmail.com

Abstract
The lichen diversity of the Caribbean region of Colombia is one of the least known in the county. In the Sierra Nevada de Santa Marta (SNSM), whose forests are at risk of disappearing due to deforestation, 114 species of lichens have been recorded. We collected lichens at elevations from 500 to 2500 m on the northwestern slopes of the SNSM, and we report six genera and 19 species from this region for the first time. Our results highlight the importance of exploring new areas to enhance our knowledge of the lichens of SNSM and Colombia.

Keywords
Coffee crops, epiphytic lichens, sub-Andean forest, Neotropics.

Academic editor: Jadson Bezerra | Received 11 July 2020 | Accepted 14 October 2020 | Published 2 November 2020

Citation: Ramírez-Roncallo K, Gómez-Ramírez H, Negritto MA (2020) New records of lichenized fungi in Sierra Nevada de Santa Marta, Colombia. Check List 16 (6): 1421–1431. https://doi.org/10.15560/16.6.1421

Introduction

Colombia is one of the countries in the Neotropics with the greatest number of lichens, with 1763 species recorded (Bernal et al. 2020). This number represents 50% of the estimated number of approximately 3600 lichen species for Colombia (Sipman et al. 2008; Lücking et al. 2009). In the country, the greatest diversity and most species are concentrated in the Andes, followed by the Caribbean region (Rangel-Ch. 2015). Rincón-Espitia et al. (2011, 2012) recorded 379 species of lichens on the plains (0–500 m a.s.l.) and in the mountain (>500 m a.s.l.) of the Caribbean region, exceeding the records of other biogeographic regions such as the Amazon and the Chocó. Later, 72 genera and 155 species were recorded in the *Catálogo de Plantas y Líquenes de Colombia* (Bernal et al. 2016). Recently, Lücking et al. (2019) surveyed the diversity of lichens in protected areas of the Atlántico department and recorded 61 species, of which 57 are new records; the authors concluded that species richness was comparable with that of other tropical dry forest sites in the Neotropics and that the remaining forests may harbor species new to science.

The Sierra Nevada de Santa Marta (SNSM) is located on the Caribbean coast of northern Colombia and has an area of approximately 17,000 km^2 covering the departments of Magdalena, Cesar, and La Guajira. It is the highest coastal mountain range in the world, with a maximum elevation of 5,775 m a.s.l. This mountain range is isolated from the Andes by large alluvial plains that descend to 160 m a.s.l. (Bernal et al. 2016). The climate and vegetation vary according to the elevation, ranging from the dry forest on the coast to the superpáramo zone in the high mountains (Pérez Preciado 1984). The

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geophysical characteristics make SNSM a region of great biological richness, with a wide variety of ecosystems that host a significant number of endemic species (Vásquez and Serrano 2009). It is a territory with great socio-cultural diversity, as it is home to several ethnic groups (Arhuaco, Kogi, Wiwa, Kankuamos, and Chimilas), peasants, fishermen, and urban populations (Arias Arias 2011). Historically, there have been several colonization events that resulted in the establishment of heterogeneous communities of settlers from Tolima, Huila, the Santanderes region, and even from other countries, who found fertile lands for commercial agriculture. Since the 19th century, coffee cultivation has been one of the main economic activities in the SNSM, and the product is recognized for its high quality (Viloria de la Hoz 2002). Coffee crops cover 20,000 ha and coffee trees are planted in the shade of larger trees. In addition, the strong pressure of the anthropogenic activities of the region have accelerated deforestation in the SNSM (Rangel-Ch. and Garzon-C. 1995), which has been very marked in recent years (IDEAM 2019), since the signing of peace treaties. This is one of the main drivers of the loss of habitat for lichens (Rangel-Ch. 2000; Aguirre-C. and Rangel-Ch. 2008). The concurrence of foreign tourism and the establishment of foreigners in the region have also contributed to human disturbances to the environment.

Knowledge about lichen species composition in the SNSM is still insufficient; research was conducted more than 50 years ago by Mägdefrau and Winkler (1967), Nowak and Winkle (1970), and Sipman (1984), which focused mainly on the north face of the mountain range. In this mountainous system, 52 genera and 114 species have been recorded so far (Bernal et al. 2020). Here we provide the results of the first explorations carried out on the northwestern slopes of the SNSM; we present data for 19 newly recorded species on this massif and the Magdalena. We include notes on the distribution and habitat of these species, and illustrations of their characteristics.

Methods

Study area. The northwestern slope of the SNSM, located in Magdalena department (Fig. 1), is characterized by a diversity of ecosystems: tropical dry deciduous forest

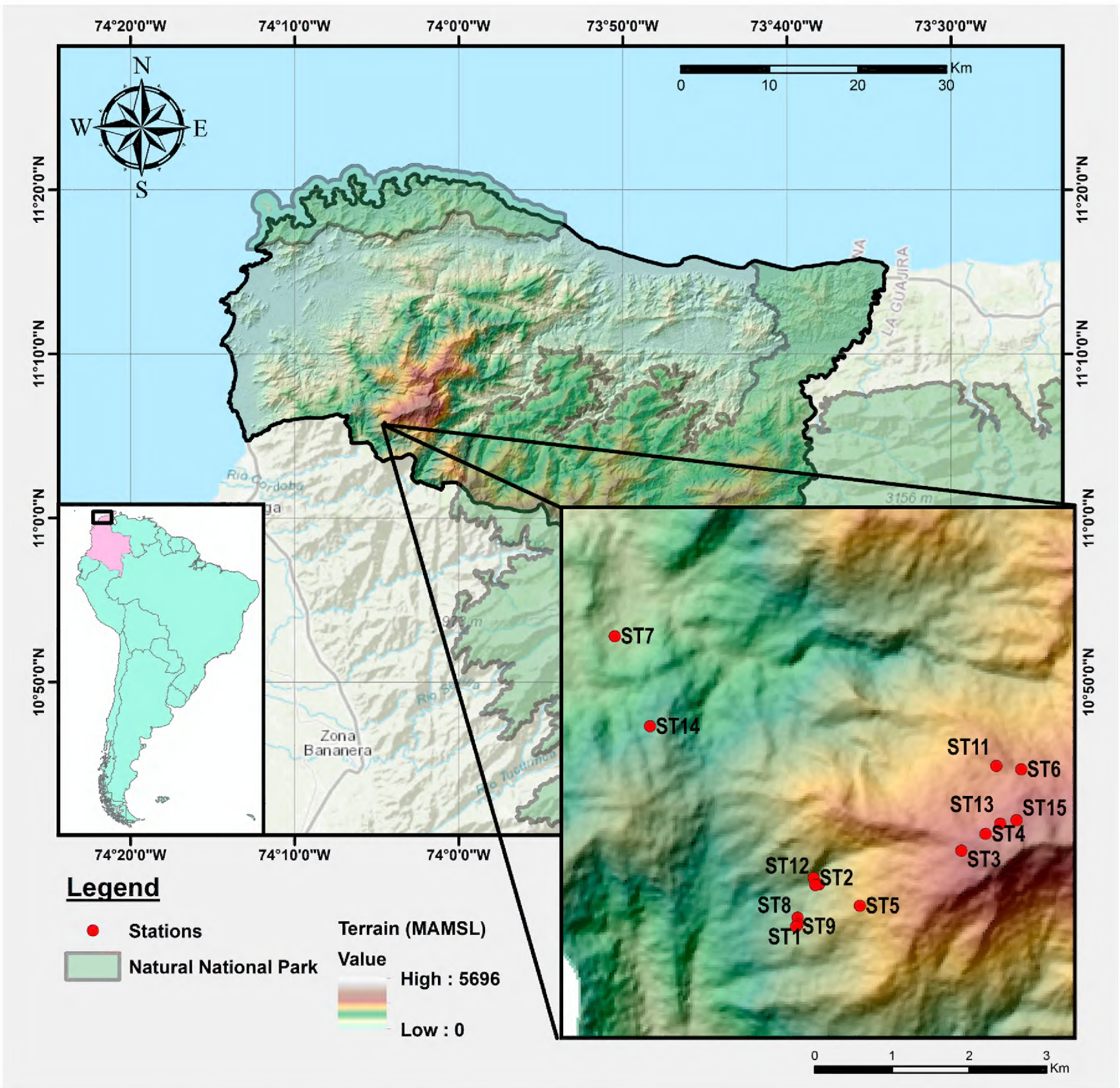

Figure 1. Map showing the study area and location of the new records.

and thorny and succulent thickets (8–180 m a.s.l.), tropical semi-deciduous forest (180–600 m a.s.l.), sub-desert ombrophilous forest (600–1800 m a.s.l.), and Andean forest (1800–2800 m a.s.l.) (Pérez Preciado 1984). The area is also characterized by a great variety of climates: arid warm, warm dry, warm humid, very humid temperate, and very humid cold (Tamarís-Turizo and López-Salgado 2006) and a unimodal-biseasonal rainfall pattern, with a longer period of precipitation between May and November, and lower precipitation from December to April (Rangel-Ch. and Carvajal-Cogollo 2012).

Sampling. Samples were collected from the forests and coffee crops of the study area, in an elevation gradient from 500 to 2500 m a.s.l., applying the opportunistic sampling method (Sipman 1996). The collection was manual, using a razor to separate the sample from the substrate. Samples were stored in paper bags, where field data were also recorded. The material was stored in a freezer at −20 °C for two days to remove invertebrates; later it was dehydrated at room temperature and stored in acid-free paper envelopes with their respective label.

Identifications. Taxonomic keys were used to identify the material. For identification of genera, keys such as Sipman (2005) and Cáceres (2007) were used. In addition to illustrations, descriptions and expert collaboration from the Grupo Colombiano de Liquenología (GCOL), specialized keys and monographs were used for species identification: *Stereocaulon* Hoffm. (Boekhout 1982; Sipman 2002; Rincón-Espitia and Mateus 2013); *Heterodermia* Trevis. and related taxa (Moberg 2011; Mongkolsuk et al. 2015; Díaz-Escandón 2017); *Ramalina* Ach. (Gumboski 2016); *Coenogonium* Ehrenb. (Rivas-Plata et al. 2006); *Bulbothrix* Hale (Benatti 2012, 2014). Chemical tests with 10% aqueous potassium hydroxide (K) and 6% sodium hypochlorite (C) were performed. Additionally, the diagnostic features of each species were photographed using a stereoscope Zeiss SteREO Discovery. V8 equipped with a Zeiss Axiocam ERc 5s microscope camera. The specimens were deposited in the Centro de Colecciones Biológicas de la Universidad del Magdalena (CBUMAG; acronym after Thiers 2016).

Data deposition. The data underpinning the analysis reported in this paper are deposited at GBIF, the Global Biodiversity Information Facility, and are available at https://doi.org/10.15468/8gkkz3 (Ramírez-Roncallo et al. 2020).

Results

Six genera were recorded for the first time for SNSM: *Bulbothrix* (Parmeliaceae), *Chrysothrix* Mont. (Chrysothricaceae), *Coenogonium* (Coenogoniaceae), *Dibaeis* Clem. (Icmadophilaceae), *Heterodermia*, and *Polyblastidium* Kalb (Physciaceae). Additionally, 19 species were recorded for the first time; data on their distribution in Colombia and the SNSM, and their diagnostic features are provided.

Bulbothrix ventricosa (Hale & Kurok.) Hale

Figure 2A

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.67′N, 074°04.87′W; 1550 m a.s.l.; 28 Jun. 2017; K. Ramírez Roncallo leg.; KRR 231; CBUMAG:LIC:403; KRR 245; CBUMAG:LIC:417 • Santa Marta, locality of Minca, Bella Vista village, Villa del Sol coffee farm; 11°05.95′N, 074°04.75′W; 1600 m a.s.l.; 29 Jun. 2017; K. Ramírez Roncallo leg.; KRR 431; CBUMAG:LIC:603; KRR 442; CBUMAG:LIC:614.

Identification. Thallus laciniate and corticolous, with laminar to marginal ciliary bulbs. Isidia abundant and concolorous, brown to black lower cortex, and presence of nordistic acid in the medulla (K + yellow → orange) (Benatti 2012).

Ecology and distribution. *Bulbothrix ventricosa* was recorded only in the Central Cordillera in Risaralda department, at between 1500 and 1725 m a.s.l., but its presence is assumed for the rest of the Colombian Andean region (Wolf 1993; Bernal et al. 2020). In the SNSM it was found on bark in coffee crops in sub-Andean forest between 1550-1600 m a.s.l.

Chrysothrix candelaris (L.) J.R. Laundon

Figure 2B

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Cerro Kennedy, San Lorenzo zone; 11°06.14′N, 074°03.70′W; 2410 m a.s.l.; 31 Jul. 2015; K. Ramírez Roncallo leg.; KRR 28; CBUMAG:LIC:193.

Identification. Thallus crustose, leprous, irregularly growing, composed of scattered and continuous granules, bright yellow, usually with orange or greenish shades; soralia present on the entire surface (Laundon 1981).

Ecology and distribution. *Chrysothrix candelaris* was recorded in the departments of Antioquia, Boyacá, Cauca, Cundinamarca, Huila, and Tolima, in lowlands and moors, at between 110 and 3130 m a.s.l., on bark and leaves (Sipman 1997; Sipman et al. 2000; BGBM 2016; Raz and Agudelo 2019; Bernal et al. 2020). In SNSM, this species was found on bark, in the Andean forest, at 2410 m a.s.l.

Coenogonium linkii Ehrenb.

Figure 2C

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Cerro Kennedy, San Lorenzo zone; 11°06.26′N, 074°03.53′W; 2500 m a.s.l.; 17 Aug. 2016; K. Ramírez Roncallo leg.; KRR 187; CBUMAG:LIC:359 • Santa Marta, locality of Minca, La Tagua village; 11°05.75′N, 074°04.42′W; 1830 m a.s.l.; 17 Aug. 2016; K. Ramírez Roncallo leg.; KRR 190; CBUMAG:LIC:362 • Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.67′N, 074°04.87′W; 1550 m a.s.l.; 28 Jun. 2017, K. Ramírez Roncallo leg.; KRR 237; CBUMAG:LIC:409.

Identification. Thallus filamentous, forming a shelf-like structure, projecting more or less perpendicular to the

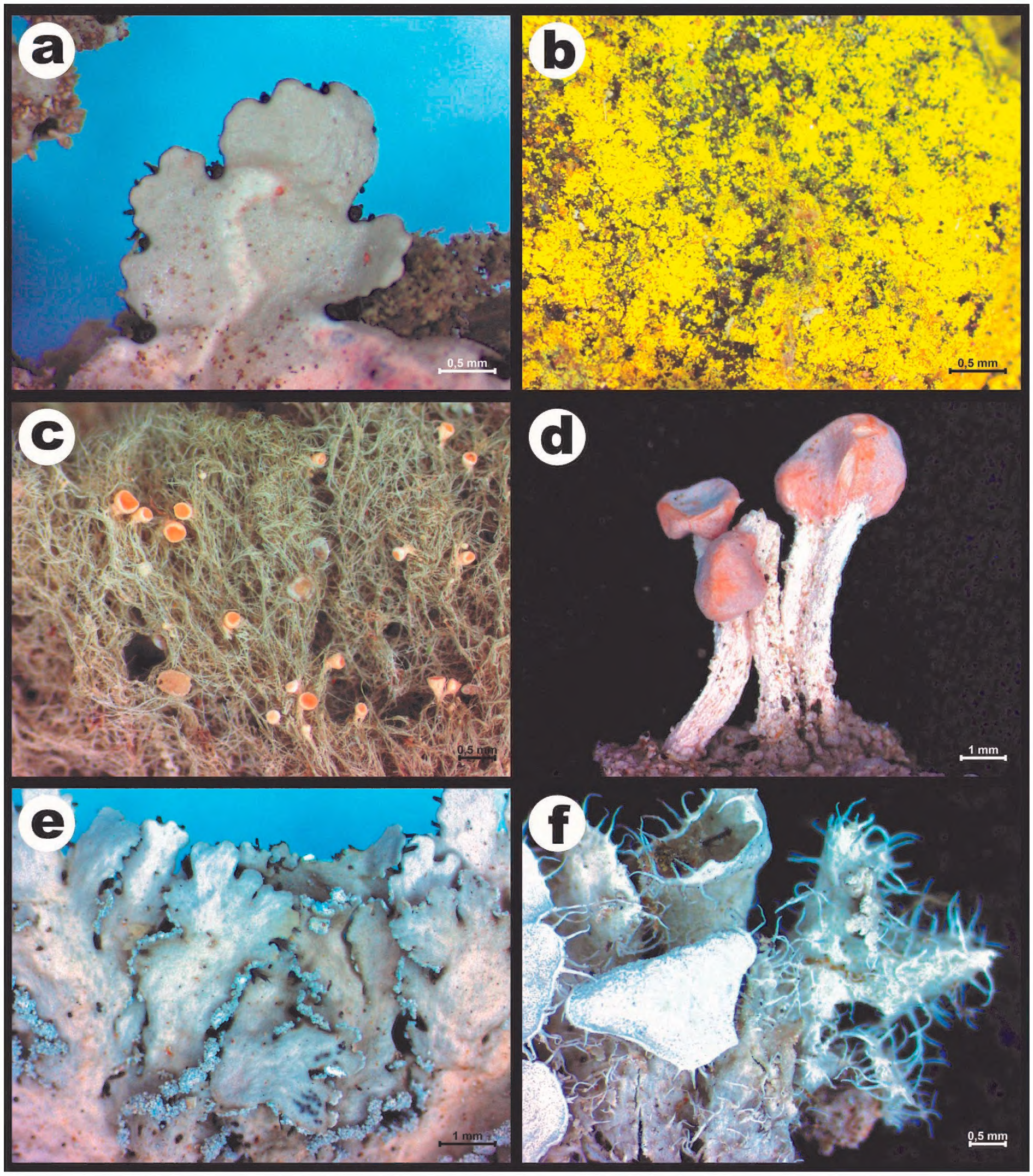

Figure 2. A. Laciniate lobules with ciliary bulbs of *Bulbothrix ventricosa* (KRR 231). **B.** Leprous thallus with soralia of *Chrisothrix candelaris* (KRR 28). **C.** Filamentous thallus with orange apothecia of *Coenogonium linkii* (KRR 190). **D.** Podetia with single pink apothecia of *Dibaeis columbiana* (KRR 62). **E.** Crenulate margin lobes and marginal soralia of *Heterodermia albicans* (KRR 295). **F.** Orbicularly growing lobes with laminar cilia of *Heterodermia comosa* (KRR 243).

substrate; filaments compact; surface bright green, ecorticated. Apothecia yellow-orange and ascospores irregularly uniseriate (Rivas-Plata et al. 2006).

Ecology and distribution. *Coenogonium linkii* was recorded in the departments of Antioquia, Cauca, Cesar, Córdoba, Cundinamarca, La Guajira, Meta, Nariño, Santander, and Valle del Cauca, in lowlands in premontane and humid forest at between 35 and 2500 m a.s.l. on bark and leaves (Soto Medina and Bolaños 2010; Rincón-Espitia et al. 2012; BGBM 2016; Raz and Agudelo 2019; Bernal et al. 2020). In SNSM it was found on bark and leaves in secondary forests and coffee crops of the sub-Andean forest, from 1550 to 2500 m a.s.l.

***Dibaeis columbiana* (Vain.) Kalb & Gierl**
Figure 2D

Materials examined. COLOMBIA • Magdalena: Santa Marta, locality of Minca, San Lorenzo zone; 11°06.71′N, 074°03.27′W; 2250 m a.s.l.; 14 Nov. 2015; K. Ramírez

Roncallo leg.; KRR 92; CBUMAG:LIC:257.

Identification. Thallus dimorphic, with crustose primary thallus, composed of compact granules, light gray to pale beige; podetia covered with smaller granules; apothecia single, balloon-shaped, pink to pale pink (Gierl and Kalb 1993).

Ecology and distribution. *Dibaeis columbiana* was recorded in the departments of Boyacá, Cundinamarca, Meta, Quindío, and Tolima, in the páramos between 3000 and 3950 m a.s.l. (Sipman et al. 2000; Bernal et al. 2020). In the SNSM it was recorded in the Andean forest, at 2250 m a.s.l., expanding its altitudinal distribution range, on soil and rocks, in open and closed sites.

***Heterodermia albicans* (Pers.) Swinscow & Krog**
Figure 2E

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, route from La Victoria to Pozo Azul; 11°07.65′N, 074°06.16′W, 890 m a.s.l., 21 Mar. 2015, A. Daza et al. leg.; SLO080-2; CBUMAG:LIC:113 • Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.62′N, 074°04.87′W; 1520 m a.s.l.; 28 Jun. 2017; K. Ramírez Roncallo leg.; KRR 277; CBUMAG:LIC:449; KRR 295; CBUMAG:LIC:467 • Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.61′N, 074°04.88′W; 1510 m a.s.l.; 28 Jun. 2017; K. Ramírez Roncallo leg.; KRR 311; CBUMAG:LIC:483.

Identification. Margin lobes wide, convergent, and crenulate; marginal soralia continuous (Díaz-Escandón 2017).

Ecology and distribution. *Heterodermia albicans* was recorded in the departments of Antioquia, Boyacá, Caldas, Cauca, Cundinamarca, Risaralda, Santander and Valle del Cauca, in lowlands and Andean foothills, at between 500 and 2700 m a.s.l., on bark, rocks, and wooden fences (Wolf 1993; Simijaca Salcedo et al. 2001; Díaz-Escandón 2017; Bernal et al. 2020). In SNSM it was found on bark and wood in secondary forest and coffee crops in the sub-Andean forest between 890 and 1520 m a.s.l.

***Heterodermia comosa* (Eschw.) Follmann & Redón**
Figure 2F

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.67′N, 074°04.87′W; 1550 m a.s.l.; 28 Jun. 2017; K. Ramírez Roncallo leg.; KRR 243; CBUMAG:LIC:415.

Identification. Lobes wide, orbicularly growing; cilia laminar (Díaz-Escandón 2017).

Ecology and distribution. *Heterodermia comosa* was recorded in the departments of Antioquia, Boyacá, Cundinamarca, Huila, Nariño, Risaralda, Santander and Valle del Cauca, in Andean forests, páramos and subpáramos, from 1500 to 3000 m a.s.l., on bark, palms and wood (Díaz-Escandón 2017; Bernal et al. 2020). In SNSM, it was found in coffee crops in the sub-Andean forest, on bark, at 1550 m.

***Heterodermia diademata* (Taylor) D.D. Awasthi**
Figure 3A

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.67′N, 074°04.87′W; 1550 m a.s.l., 28 Jun. 2017, K. Ramírez Roncallo leg.; KRR 252; CBUMAG:LIC:424 • Santa Marta, locality of Minca, Bella Vista village, Villa del Sol coffee farm; 11°05.9′N, 074°04.71′W; 1640 m a.s.l.; 29 Jun. 2017; K. Ramírez Roncallo leg.; KRR 326; CBUMAG:LIC:498; KRR 340; CBUMAG:LIC:512; KRR 367; CBUMAG:LIC:539.

Identification. Soralia, isidia, and phyllidia absent; margins are pseudocyphellate due to the breakage of small lobes. Apothecia with a crenulated margin; ascospores without sporoblastidia (*Pachyspora* type) (Díaz-Escandón 2017).

Ecology and distribution. *Heterodermia diademata* was recorded in the departments of Casanare, Cauca, Nariño, Risaralda, and Santander, on wood and live fences in the high Andean forest from 1200 to 2500 m a.s.l. (Díaz-Escandón 2017; Bernal et al. 2020). In SNSM, it was found in coffee crops in the sub-Andean forest, between 1550 and 1640 m a.s.l., on bark.

***Heterodermia flabellata* (Fée) D.D. Awasthi**
Figure 3B

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.67′N, 074°04.87′W; 1550 m a.s.l., 28 Jun. 2017; K. Ramírez Roncallo leg.; KRR 250; CBUMAG:LIC:422.

Identification. Lower surface ecorticate, arachnoid and covered with an ocher pigment. Vegetative propagules absent (Díaz-Escandón 2017).

Ecology and distribution. *Heterodermia flabellata* was recorded in the departments of Antioquia, Boyacá, Casanare, Cauca, Cundinamarca, Huila, Meta, Nariño, Norte de Santander, Putumayo, Risaralda, Santander and Tolima, in foothills and high Andean forests and sub-paramo, from 1300 to 3000 m a.s.l., on bark and wood in good condition (Díaz-Escandón 2017; Bernal et al. 2020). In SNSM, it was found on bark in coffee crops in the sub-Andean forest, at 1550 m a.s.l.

***Heterodermia galactophylla* (Tuck.) W.L. Culb.**
Figure 3C

Materials examined. COLOMBIA • Magdalena: Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.62′N, 074°04.87′W; 1520 m a.s.l.; 28 Jun. 2017; N. Cantillo et al. leg.; CIIB3; CBUMAG:BRY:00973-4 • Santa Marta, locality of Minca, Bella Vista village, Villa del Sol coffee farm;11°05.9′N, 074°04.71′W; 1640 m a.s.l.; 29 Jun. 2017; K. Ramírez Roncallo leg.; KRR 380; CBUMAG:LIC:552.

Identification. Lobes with widened and ascending apices; soralia labriform and medulla with atranorin (K + yellow) (Mongkolsuk et al. 2015; Díaz-Escandón 2017).

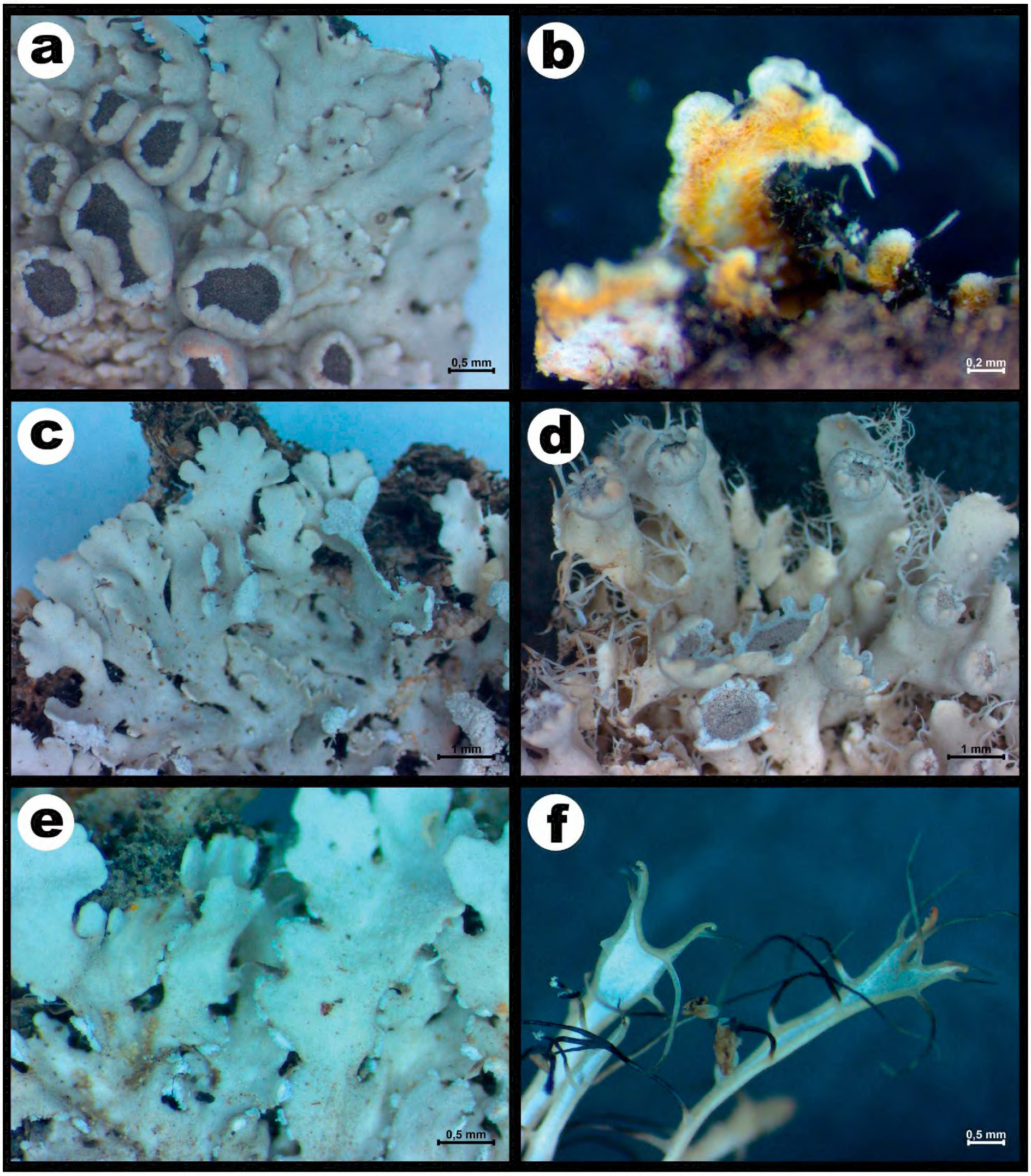

Figure 3. A. Pseudocyphellate margins and apothecia with a crenulated margin of *Heterodermia diademata* (KRR 326). **B.** Ecorticate lower surface covered with an ocher pigment of *Heterodermia flabellata* (KRR 250). **C.** Lobes with widened and ascending apices and labriform soralia of *Heterodermia galactophylla* (KRR 380). **D.** Terminal apothecia with lobed margins of *Heterodermia podocarpa* (KRR 333). **E.** Lobes with excavate margins and lateral soralia of *Heterodermia pseudospeciosa* (KRR 225). **F.** Lobes with bifurcated, slightly circinate apices of *Leucodermia boryi* (CIA2-2).

Ecology and distribution. *Heterodermia galactophylla* was recorded in the departments of Antioquia, Boyacá, Caldas, Cauca, Cundinamarca, Huila, Nariño, Norte de Santander, Quindío, Risaralda, Santander, Tolima, and Valle del Cauca, on bark in Andean forests, paramo, sub-páramos, at between 1000 and 3730 m a.s.l. (BGBM 2016; Díaz-Escandón 2017; Raz and Agudelo 2019; Bernal et al. 2020). In SNSM, it was found on bark in coffee crops in the sub-Andean forest, between 1520 and 1640 m a.s.l.

***Heterodermia podocarpa* (Bél.) D.D. Awasthi**

Figure 3D

Materials examined. COLOMBIA • Magdalena: Santa Marta, locality of Minca, Bella Vista village, Villa del Sol coffee farm;11°05.9′N, 074°04.71′W; 1640 m a.s.l., 29 Jun. 2017, K. Ramírez Roncallo leg.; KRR 333; CBUMAG:LIC:505; KRR 362; CBUMAG:LIC:534; KRR 379; CBUMAG:LIC:551.

Identification. Terminal apothecia with lobed margins; soralia, isidia and phyllidia absent (Díaz-Escandón 2017).

Ecology and distribution. *Heterodermia podocarpa* was recorded in the departments of Antioquia, Boyacá, Caldas, Casanare, Cauca, Cundinamarca, Huila, Nariño, Norte de Santander, Putumayo, Quindío, Risaralda, Santander, Tolima, and Valle del Cauca, in Andean forests, páramos, and subpáramos, on bark, palms and wood in good condition from 1500 to 3000 m a.s.l. (Díaz-Escandón 2017; Bernal et al. 2020). In SNSM, it was recorded on bark in coffee crops in the sub-Andean forest at 1640 m a.s.l.

***Heterodermia pseudospeciosa* (Kurok.) W. L. Culb.**
Figure 3E

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.67′N, 074°04.87′W; 1550 m a.s.l.; 28 Jun. 2017; K. Ramírez Roncallo leg.; KRR 225; CBUMAG:LIC:397.

Identification. Lobes with excavate or pseudocyphellate margins, forming non-convergent lateral soralia; presence of nordistic acid in the medulla (K + red) (Díaz-Escandón 2017).

Ecology and distribution. *Heterodermia pseudospeciosa* has been recorded in the departments of Cauca, Cundinamarca, Risaralda, and Valle del Cauca, in lowlands, foothills of the Andean mountains, and Andean forests, from 900 to 2700 m a.s.l., on bark, rocks, and wooden fences (Díaz-Escandón 2017). In SNSM, it was found in coffee crops in the sub-Andean forest, at 1550 m a.s.l., on bark.

***Leucodermia boryi* (Fée) Kalb**
Figure 3F

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, San Lorenzo zone; 11°06.73′N, 074°03.45′W, 2220 m a.s.l., 21 Mar. 2015, A. Daza et al. leg.; SLO061-2; CBUMAG:BRY:00319-2 • Santa Marta, locality of Minca, Bella Vista village, Villa del Sol coffee farm; 11°05.9′N, 074°04.71′W; 1640 m a.s.l.; 29 Jun. 2017; N. Cantillo et al. leg.; CIA2-2; CBUMAG:BRY:00960-3 • Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.62′N, 074°04.87′W; 1520 m a.s.l., 28 Jun. 2017, N. Cantillo et al. leg.; CIIB1; CBUMAG:BRY:00971-2.

Identification. Very similar to *L. leucomelos*, but differs in having lobes with bifurcated, slightly circinate apices (Díaz-Escandón 2017).

Ecology and distribution. *Leucodermia boryi* has been recorded in the departments of Boyacá, Caldas, Casanare, Cauca, Cundinamarca, Nariño, Norte de Santander, Tolima, and Valle del Cauca, in sub-Andean and Andean forests from 1500 to 3000 m a.s.l., on bark, along with other species of the same genus and liverworts (Díaz-Escandón 2017). In SNSM, it was found in intervened forests and coffee crops of the Andean and sub-Andean forests, between 1520 and 2220 m a.s.l., on bark.

***Heterodermia speciosa* (Wulfen) Trevis.**
Figure 4A, B

Materials examined. COLOMBIA • Magdalena: Santa Marta, locality of Minca, Bella Vista village, Villa del Sol coffee farm; 11°05.9′N, 074°04.74′W; 1620 m a.s.l.; 29 Jun. 2017, N. Cantillo et al. leg.; CIB2-5; CBUMAG:BRY:00963-5 • Santa Marta, locality of Minca, Bella Vista village Villa del Sol, coffee farm; 11°05.95′N, 074°04.75′W; 1600 m a.s.l.; 29 Jun. 2017; N. Cantillo et al. leg.; CIC1-7; CBUMAG:BRY:00965-7.

Identification. Terminal soralia labriform, capitate to subcapitate; lower surface cortical (Díaz-Escandón 2017).

Ecology and distribution. *Heterodermia speciosa* was recorded in the departments of Antioquia, Boyacá, Caldas, Cauca, Cundinamarca, Huila, Nariño, Risaralda, Santander, Tolima, and Valle del Cauca, in the Andean foothills and Andean forests, from 1000 to 3730 m a.s.l., on bark, wooden fences and rocks (Díaz-Escandón 2017; Bernal et al. 2020). In SNSM it is recorded in coffee crops in the sub-Andean forest, approximately at 1600 m a.s.l., on bark.

***Leucodermia lutescens* (Kurok.) Kalb**
Figure 4C

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.67′N, 074°04.87′W; 1550 m a.s.l.; 28 Jun. 2017; K. Ramírez Roncallo leg.; KRR 269; CBUMAG:LIC:441; KRR 276; CBUMAG:LIC:448 • Santa Marta, locality of Minca, village Bella Vista; 11°05.9′N, 074°04.71′W; 1640 m a.s.l.; 29 Jun. 2017; K. Ramírez Roncallo leg.; KRR 345; CBUMAG:LIC:517; KRR 353; CBUMAG:LIC:525; KRR 365; CBUMAG:LIC:537.

Identification. Morphologically similar to *L. leucomelos*, but differs in having medulla yellow, sometimes white and with orange-pink spots (Díaz-Escandón 2017).

Ecology and distribution. *Leucodermia lutescens* was recorded in the departments of Boyacá, Caldas, Casanare, Cauca, Cundinamarca, Nariño, Norte de Santander, Tolima, and Valle del Cauca, in sub-Andean and Andean forests from 1000 to 3000 m a.s.l., on bark along with liverworts (Díaz-Escandón 2017). In SNSM, it was found in coffee crops in the sub-Andean forest, between 1550 and1640 m a.s.l., on bark.

***Polyblastidium fragilissimum* (Kurok.) Kalb**
Figure 4D

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Cerro Kennedy; 11°06.33′N, 074°03.42′W; 2520 m a.s.l.; 31 Jul. 2015, K. Ramírez Roncallo leg.; KRR 13; CBUMAG:LIC:178.

Identification. Marginal phyllidia or squamules present; margins rugged with white macules. These

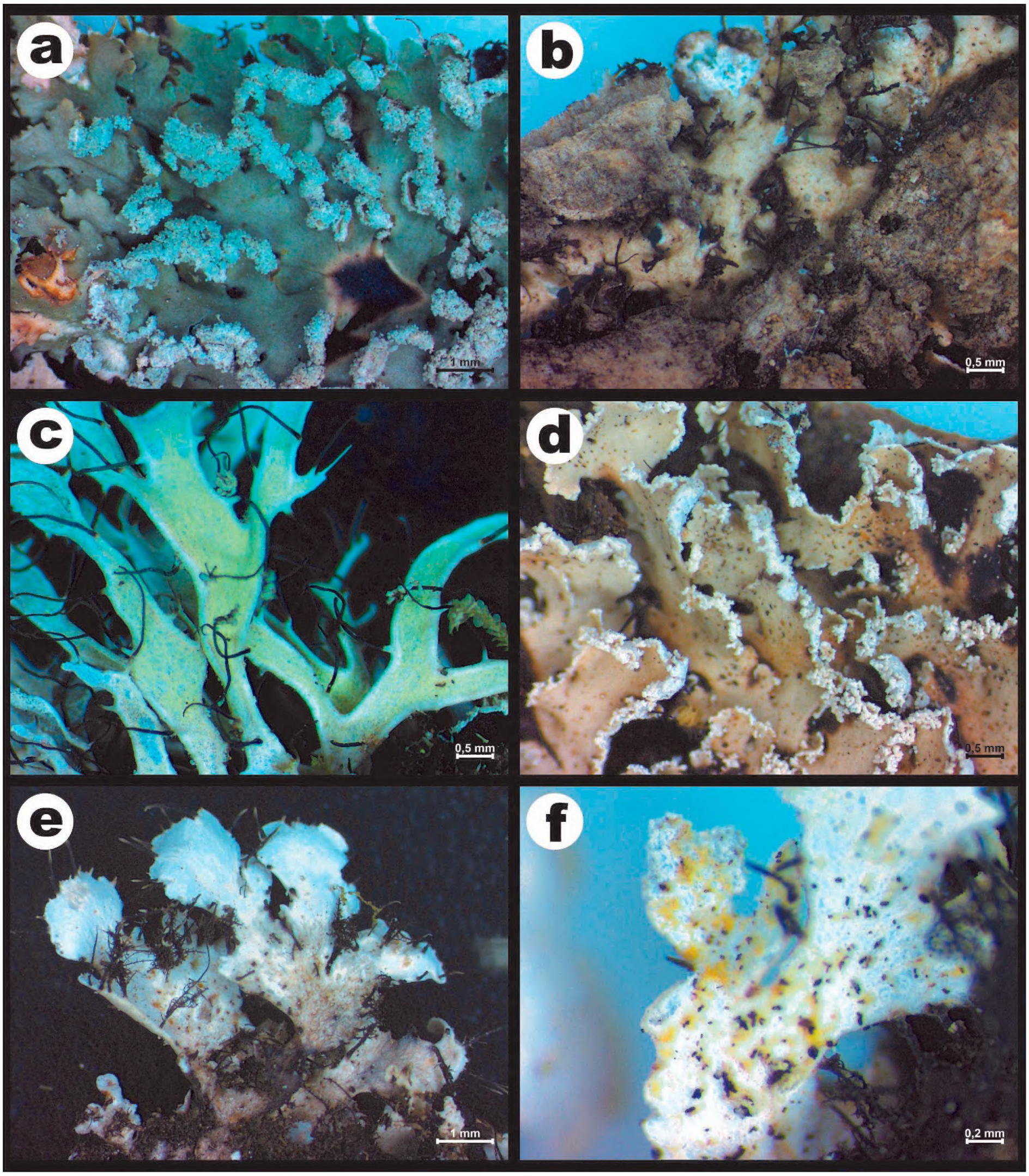

Figure 4. A. Terminal and lateral soralia of *Heterodermia speciosa* (CIB2-5). **B.** Cortical lower surface of *H. speciosa* (CIB2-5). **C.** Yellow medulla of *Leucodermia lutescens* (KRR 276). **D.** Marginal squamules and rugged margins of *Polyblastidium fragilissimum* (KRR 13). **E.** Ecorticate lower surface, white at the apex and dark towards the center of *Polyblastidium japonicum* (KRR 316). **F.** Ecorticate lower surface with small ocher pigments towards the apices of *Polyblastidium neglectum* (KRR 126).

features, together with the presence of pruine, give the thallus a fragile and brittle appearance (Díaz-Escandón 2017).

Ecology and distribution. *Polyblastidium fragilissimum* has been recorded in the departments of Boyacá, Cauca, Norte de Santander, Tolima, and Valle del Cauca, in the foothills and Andean forests from 800 to 3000 m a.s.l., on bark and mosses (Díaz-Escandón 2017). In SNSM it was found in the Andean forest, at 2520 m a.s.l., on bark.

***Polyblastidium japonicum* (M. Satô) Kalb**

Figure 4E

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, El Campano village, 11°07′N, 074°05.91′W; 1190 m a.s.l., 21 Mar. 2015, A. Daza et al. leg.; SLO079-1; CBUMAG:LIC:109 • Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.67′N, 074°04.87′W; 1550 m a.s.l.; 28 Jun. 2017; K. Ramírez Roncallo leg.; KRR 222; CBUMAG:LIC:394;

KRR 227; CBUMAG:LIC:399; KRR 240; CBUMAG:LIC:412; KRR 249; CBUMAG:LIC:421; KRR 254; CBUMAG:LIC:426; KRR 268; CBUMAG:LIC:440; KRR 275; CBUMAG:LIC:447 • Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.62′N, 074°04.87′W; 1520 m a.s.l., 28 Jun. 2017, K. Ramírez Roncallo leg.; KRR 282; CBUMAG:LIC:454; KRR 297; CBUMAG:LIC:469; KRR 300; CBUMAG:LIC:472; KRR 303; CBUMAG:LIC:475 • Santa Marta, locality Minca, village Bella Vista, coffee farm Villa del Sol; 11°05.9′N, 074°04.71′W; 1640 m a.s.l., 29 Jun. 2017, K. Ramírez Roncallo leg.; KRR 329; CBUMAG:LIC:501.

Identification. Soralia terminal, labriform, lower surface ecorticate, slightly arachnoid, white at the apex and dark towards the center; medulla with atranorin (K + yellow) (Mongkolsuk et al. 2015; Díaz-Escandón 2017).

Ecology and distribution. *Polyblastidium japonicum* has been recorded in the departments of Antioquia, Boyacá, Caldas, Casanare, Cauca, Cundinamarca, Huila, Nariño, Norte de Santander, Quindío, Risaralda, Santander, and Valle del Cauca, in the foothills and Andean forests from 800 to 3500 m a.s.l., on bark, live fences and wood in good condition (Díaz-Escandón 2017). In SNSM, it was found on decaying bark and wood in the sub-Andean and Andean forest, between 1190 and 1640 m a.s.l.

***Polyblastidium neglectum* (Lendemer, R.C. Harris & E.A. Tripp) Kalb**

Figure 4F

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Cerro Kennedy San Lorenzo zone; 11°06.35′N, 074°03.31′W; 2560 m a.s.l.; 17 Aug. 2016; K. Ramírez Roncallo leg.; KRR 126; CBUMAG:LIC:298 • Santa Marta, locality of Minca, Bella Vista village, Villa del Sol coffee farm; 11°05.9′N, 074°04.71′W; 1640 m a.s.l.; 29 Jun. 2017; K. Ramírez Roncallo leg.; KRR 338; CBUMAG:LIC:510.

Identification. Soralia lateral and lower surface ecorticate, slightly arachnoid, with small ocher pigments towards the apices K + red (Díaz-Escandón 2017).

Ecology and distribution. *Polyblastidiu neglectum* has been recorded in the departments of Boyacá, Cauca, Cundinamarca, Risaralda, Santander, Tolima and Valle del Cauca, in Andean forests and páramos, from 1800 to 3500 m a.s.l., on bark, live fences, and wood in good condition (Díaz-Escandón 2017). In SNSM, it was found on bark in disturbed forests and coffee crops in the Andean and sub-Andean forests, from 1640 to 2560 m a.s.l.; the new records expand this species' altitudinal distribution range.

***Ramalina cochlearis* Zahlbr.**

Figure 5A

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.67′N, 074°04.87′W, 1550 m a.s.l..; 28 Jun. 2017; K. Ramírez Roncallo leg.; KRR 238; CBUMAG:LIC:410; KRR 274; CBUMAG:LIC:446 • Santa Marta, locality of Minca, Bella Vista village, Villa Kelly coffee farm; 11°05.61′N, 074°04.88′W; 1510 m a.s.l.; 28 Jun. 2017; K. Ramírez Roncallo leg.; KRR 317; CBUMAG:LIC:489; KRR 320; CBUMAG:LIC:492 • Santa Marta, locality of Minca, Bella Vista village, Villa del Sol coffee farm, 11°05.9′N, 074°04.71′W, 1640 m a.s.l.; 29 Jun. 2017, K. Ramírez Roncallo leg.; KRR 327; CBUMAG:LIC:499.

Identification. Branches flattened to weakly canaliculate; soralia terminal, helmet-shaped (Gumboski 2016).

Ecology and distribution. *Ramalina cochlearis* has been recorded in the departments of Antioquia, Boyacá, Cauca, Cundinamarca, Huila, Quindío, Risaralda, Santander and Tolima, on bark in rain forests and moors from 1250 to 3130 m a.s.l. (García et al. 2018; Bernal et al. 2020). In SNSM, it was recorded in coffee crops in the sub-Andean forest, between 1510 and 1640 m a.s.l., on bark.

***Stereocaulon meyeri* Stein**

Figure 5B

Materials examined. COLOMBIA • Magdalena, Santa Marta, locality of Minca, Cerro Kennedy; 11°06.32′N,

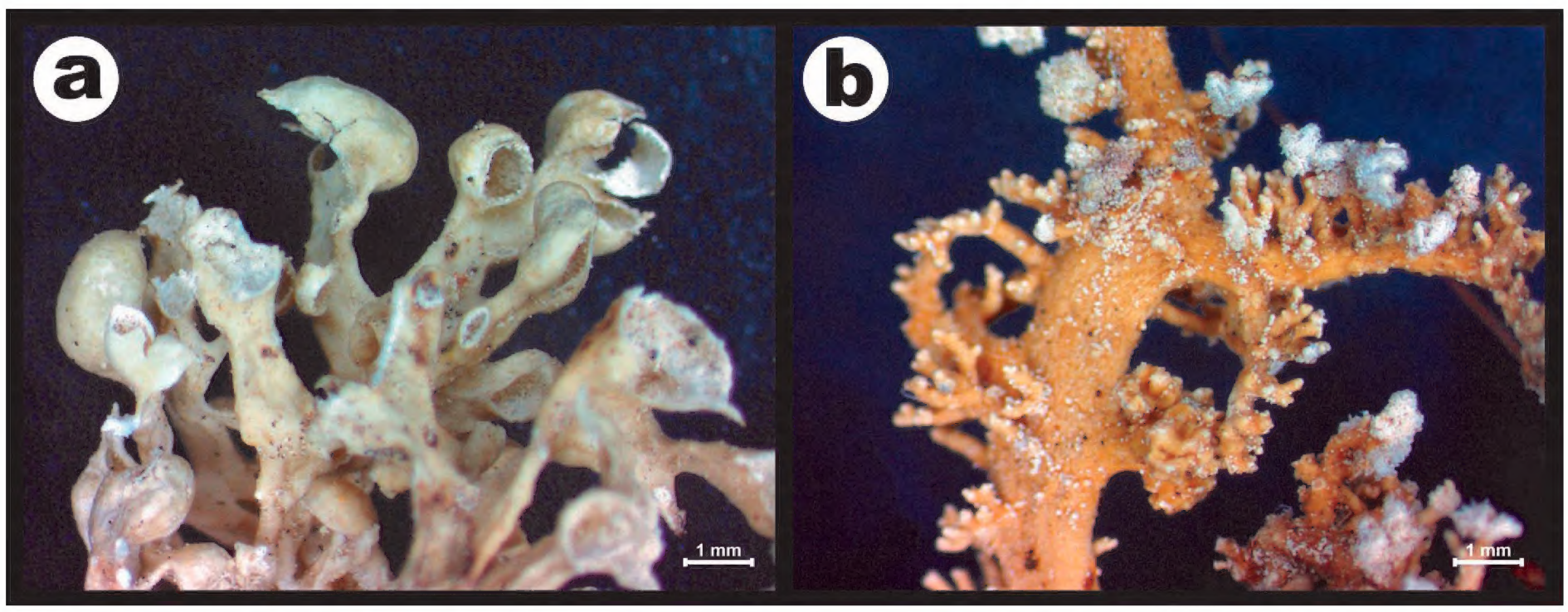

Figure 5. A. Terminal helmet-shaped soralia of *Ramalina cochlearis* (KRR 277). **B.** Branched pseudopodetia, sacculate cephalodia, and terminal soralia of *Stereocaulon meyeri* (KRR 24).

074°03.42′W; 2520 m a.s.l., 31 Jul. 2015; K. Ramírez Roncallo leg.; KRR 24; CBUMAG:LIC:189.

Identification. Pseudopodetia coralloid, highly branched at the apex; cylindrical phyllocladia covering the pseudopodetia, shorter towards the apex. Cephalodia sacculate, soralia terminal, and ascocarps black (Boekhout 1982; Sipman 2002; Rincón-Espitia and Mateus 2013).

Ecology and distribution. *Stereocaulon meyeri* was recorded in the departments of Boyacá, Caldas, Cundinamarca, Risaralda, Santander, and Tolima, on soil in páramos from 3100 to 4300 m a.s.l. (Rincón-Espitia and Mateus 2013; Bernal et al. 2020). In SNSM, it was found on clay soil and rocks, in open sites, next to the road in the Andean forest at 2520 m a.s.l.; the new record expands this species' altitudinal distribution range.

Discussion

Six genera and 19 species of lichens were recorded from Magdalena department and the SNSM for the first time, which brings the number of genera and species to 58 and 133, respectively, for this mountain region (Bernal et al. 2020). In addition, the altitudinal ranges of *Dibaeis columbiana*, *Polyblastidium neglectum*, and *Stereocaulon meyeri* are expanded.

Two species of *Heterodermia* were recorded in the SNSM: *H. circinalis* (Zahlbr.) W. A. Weber and *H. leucomelos* (L.) Poelt (Bernal et al. 2020). However, both were transferred to the genus *Leucodermia* by Kalb (Mongkolsuk et al. 2015). Therefore, the *Heterodermia* species found in our study represent the first records of *Heterodermia* for this mountain range.

We obtained new records of 19 species, although only a small part of the SNSM was explored. For this reason, the sampling area should be expanded to especially include sites that have not yet been explored to obtain more precise knowledge about the composition of lichens in this region (Rincón-Espitia et al. 2011, 2012; Lücking et al. 2019).

Acknowledgements

We are grateful to the Ministerio de Ciencia, Tecnología e Innovación (Minciencias) and the Vice-Rectory for Research at the Universidad del Magdalena for financial support, to the Grupo Colombiano de Liquenología (GCOL) for providing the specialized literature and confirming the identification of many species, and to the project "Functional diversity of corticolous lichens in disturbed forests of a tropical coastal mountain".

This is the scientific contribution no. 15 from the Centro de Colecciones Biológicas de la Universidad del Magdalena (CBUMAG).

Authors' Contributions

KRR – specimen collection and identification, writing and revision of the manuscript. HGR – identification of specimens and writing of the manuscript. MAN – specimen collection, writing, and revision of the manuscript.

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